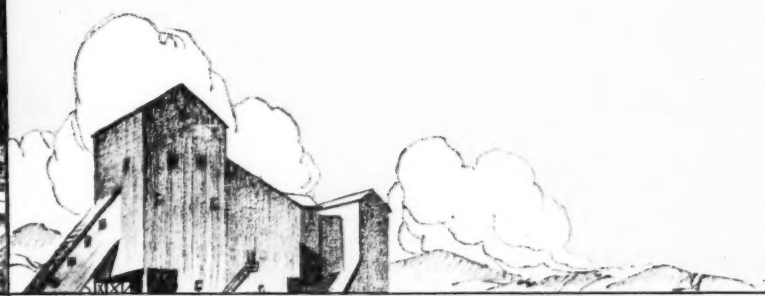
The CRUSHED STONE JOURNAL

In This Issue

- Stabilized Quarry Fines for Base Construction
- Low Cost Roads Will Multiply Stone Markets
- Future Policies in State and Federal Road Building



March-April · 1937

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

Technical Publications

of the

National Crushed Stone Association, Inc.

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BULLETIN No. 1

The Bulking of Sand and Its Effect on Concrete

BULLETIN No. 2

Low Cost Improvement of Earth Roads with Crushed Stone

BULLETIN No. 3

The Water-Ratio Specification for Concrete and Its Limitations

BULLETIN No. 4

"Retreading" Our Highways

BULLETIN No. 5

Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey" with Discussion

BULLETIN No. 6

The Bituminous Macadam Pavement

BULLETIN No. 7

Investigations in the Proportioning of Concrete for Highways

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The Effect of Transportation Methods and Costs on the Crushed Stone, Sand and Gravel, and Slag Industries

BULLETIN No. 9

Tests for the Traffic Durability of Bituminous Pavements

BULLETIN No. 10

Stone Sand

Single copies of the above bulletins are available upon request.

The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

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Contents

Page

Stabilized Quarry Fines for Base Construction
—C. L. McKesson - - - 3

Low Cost Roads Will Multiply Stone Markets
—Ray A. Giddings - - - 7

Future Policies in State and Federal Road Building
—W. C. Markham - - - 11

STABILIZED HIGHWAY
Crest Route in
San Bernardino Mountains

THE
CRUSHED STONE JOURNAL
WASHINGTON, D. C.
Vol. XII No. 2 MARCH-APRIL, 1937

Stabilized Quarry Fines for Base Construction[1]

By C. L. McKESSON
Vice-President, American Bitumuls Co.,
San Francisco, California

◆ An interesting use for stone screenings mixed with bituminous emulsion and clay is described by Mr. McKesson. Apparently such a mixture develops high stability and forms an excellent base for use in low cost roads.

THE PAST several years have seen many important changes in the processes of road building and a marked movement away from the old idea that the only safe way to provide for increasing volume and weight of traffic was to ignore subgrade and attempt to bridge over weak and yielding subgrades with heavy slabs of pavement. Soil studies have made possible the construction of more uniform and better subgrades. Densely graded crushed rock, compacted by traffic or rolling, has provided low cost, non-rigid bases which distribute the load to subgrade, and which could be surfaced with inexpensive non-rigid bituminous surfaces.

With the dense, finely crushed rock surfacing and base it has been found necessary to carefully control the grading, and to guard against excessive quantities of fines or clayey materials which would give instability in wet weather.

Utilization of Quarry Waste as Base Material

As a result of specifications requiring careful selection of materials, almost every quarry has large spoil banks of quarry waste consisting of crusher dust, clayey strippings and soft or weathered rock or overburden. The cost of these waste piles has usually been written off as a natural loss in rock production. The purpose of this paper is to show that these waste materials can now profitably be converted into high class base material and thus can be made useful and saleable.

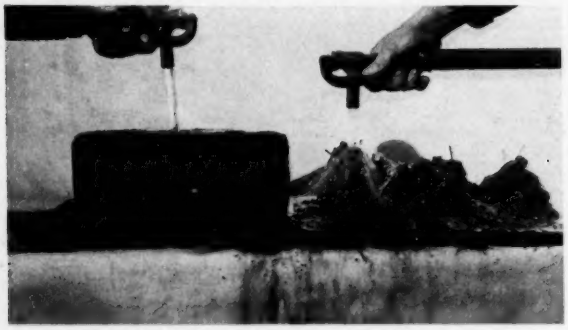
Of the recent changes in road building, "Soil Stabilization" is the most revolutionary and the most intriguing. In a paper presented to the National Highway Research Board and published in their 1935 Proceedings, the writer discussed in detail the practices by which even unstable clay soils could, by treatment with emulsified asphalt, be converted into durable, water resistant, load supporting bases. Examples were cited of successful construction of this kind in every section of the United States. Time will not permit a full discussion of the principles of stabilization here, and those interested in the technical details of stabilization are referred to the paper above mentioned.

While natural soils can be made into good base material by treatment with asphaltic emulsion, the quantity of asphaltic emulsion is in proportion to the fineness of the soil. Quarry waste and similar materials containing granular particles and less clay and dust, may be stabilized with proportionately less quantities of emulsified asphalt. The natural inherent stability of rocky mineral aggregate at the same time adds to the superior qualities of the stabilized base. The reduced cost of emulsified asphalt

[1] Presented at the Twentieth Annual Convention of the National Crushed Stone Association at Cincinnati, Ohio, January 18-20, 1937.

and lower cost for mixing, over that involved in soil treatment, leaves a reasonable price for the waste rock materials, and a profit for handling.

Because it is water resistant and has greater load distributing strength, a stabilized quarry waste base is actually more valuable than an untreated base constructed out of carefully selected and high grade crushed stone products. This radical statement is amply supported by field experience.



WATER RESISTANCE OF TREATED AND UNTREATED CLAY BINDER

You are all familiar with the construction of waterbound base mixtures in which clay or cementitious stone dust acts as the binding material for coarser mineral aggregates. In successful work of this type the very fine cementitious particles are combined with the coarser materials in sufficient quantity to act as a binder, but in too small a quantity to act as a lubricant for the rock particles when the base absorbs moisture. This type of work necessitates precise control as to gradings and selection of binder material, otherwise the base ravels when dry, or becomes muddy and unstable when wet.

The strength of the cementitious binder, however, is only developed through drying, and is *maintained only as long as the binder remains in a substantially dry condition.* It is impossible to so construct a highway as to keep all moisture from penetrating the base and the proportions of the binder and aggregate have, of necessity, been controlled within narrow limits so that when the binder became wet the rock particles maintained intimate contact with each other and frictional resistance prevented entire loss of stability in the base.

Preparation of Stabilized Base Mixtures with Emulsified Asphalt

Stabilized base mixtures still depend upon cementitious rock dust or even pure clay as the binding medium for the rock and sand particles. Due to the fact that the binder is waterproofed in this process, an excess of cementitious material or clay can be used and the road develops even greater strength and supporting power than the well graded untreated base materials. Due to the water resistant properties, the base remains stable under all weather conditions.

In the preparation of such mixtures it is only necessary to maintain the binder content passing 200 mesh content *above* a certain minimum (usually 15%) and use a sufficient amount of the proper quality of emulsified asphalt to prevent the clay, or other binder, from taking up sufficient water to cause it to lose its cementing value and to become a lubricant. The theory behind this treatment is as follows:

The aggregate mixture is wetted with water as in the ordinary waterbound base work, but in this water is contained the proper amount of asphalt in particles of microscopic and submicroscopic size. As this water is mixed with the aggregate, these particles of asphalt are dispersed throughout the mass so that they may mingle with the fine mineral particles. In this state, the asphalt particles are tiny spheres having an average particle size of approximately 1/25,000 of an inch. As the water dries out of the mass, the water films on the fine particles become, eventually, so thin as to develop tremendous surface tension, not only in the films surrounding the fine mineral particles, but also in the films surrounding the asphalt globules. As this drying continues, this surface tension pulls the asphalt from its spherical form into films of extreme thinness, thus forming a coating of asphalt around each particle of binder. This coating is now held under a force of adsorption so great that even the asphalt is changed in its characteristics. Asphalt which was normally completely soluble in such solvents as carbon tetrachloride, is now so changed that it is no longer soluble, and a large portion cannot be removed from the mixture even with boiling carbon tetrachloride.

The surfaces of these cementitious rock or clay particles are thus coated with a water-repellent substance and it can readily be seen why they no longer have the affinity for water which formerly caused the loss of binding value in the presence of water.

When this treatment is properly carried out, the binder becomes a permanent one, regardless of moisture conditions, and a base constructed of these ma-

terials maintains its supporting value—in spite of seasonal moisture changes.

In this treatment, about one cubic inch of asphalt is made to coat as much as 18,000 square feet of aggregate surface, or about the equivalent of the surface of two full-size tennis courts. Such a coating would, naturally, be impossible to apply by any usual mechanical means. It is only through the action of the water and Nature's force of adsorption that a coating of such extreme thinness could be applied. This coating must, of necessity, be this thin so that it does not in any way *interfere with the natural cementing power of the cementitious dust or clay.* By comparison, the cementing power of a plastic substance such as asphalt is very weak, indeed.

Determination of the Proper Amount of Emulsified Asphalt

When mixtures of this kind are tested for stability with various quantities of contained asphalt, it is found that a definite optimum point is developed when the proper film thickness is reached. Beyond this point, greater amounts of asphalt detract from the natural stability of the mixture. Below this point, lesser amounts of asphalt allow water infiltration, also developing loss of stability. For this reason, the amount of emulsified asphalt used must be controlled by laboratory tests. Once the proper amount of emulsified asphalt is determined for any one aggregate, based on the fines content of the mixture, it is then possible to control the quantity through varying the amount of emulsified asphalt in direct proportion to the amount of 200-mesh fines present in the mixture.

Important Characteristics of Emulsified Asphalt

In the foregoing, emulsified asphalt stabilizer has been mentioned without an explanation as to its makeup.

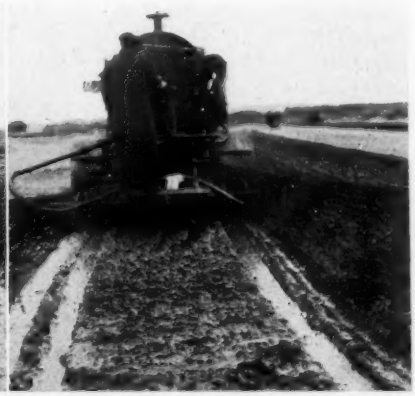
Most rock producers are familiar with the emulsified asphalt normally used in binding rock together, either by the mixing or the penetration method, and emulsified asphalt for stabilization is very similar in its appearance. It is, however, necessary that emulsion for this use be made particularly for soil stabilization, as several characteristics of the emulsified asphalt are of great importance.

First, it is necessary that the emulsion be manufactured so that the particles of asphalt going to make up the product are of extreme fineness and of carefully controlled uniformity. The reason for the necessity for fineness is that these asphalt particles must be distributed throughout the binder mass in as many points as possible, so that it can be easily taken up as a coating by the fine particles. Large asphalt particles would not coat an equally large number of soil grains, and for this reason are not effective in the process. They also have a tendency to settle out of the emulsion in storage because of their greater mass, particularly after the emulsion has been diluted for use.

Another necessity is that the emulsion contain no appreciable amount of soap or other soluble emulsifying agents, as any such soluble ingredients are left behind when the water has evaporated, and they leave a path by which water can again enter the mixture.

MIXING WITH HARROWS

ADDING CRUSHED ROCK TO BE MIXED INTO SOIL—BURLINGTON, VERMONT, AIRPORT



APPLYING STABILIZING EMULSION AND WATER

The so-called soap emulsions are entirely unsuited for use in soil stabilization, not only for this reason, but also because of the fact that they are not sufficiently stable to allow of their being mixed with graded aggregate mixtures without coagulation of the particles, so that instead of having a good distribution of asphalt, a very poor one results.

GENERAL VIEW OF BURLINGTON AIRPORT SHOWING FINISHED SECTIONS

Several other characteristics of the emulsion are of importance in this work, such as the hardness of the asphalt and the rate of drying of the emulsion. All of these should be controlled by strict specifications.

As previously stated, the optimum quantity of emulsified asphalt to be used with any one material is determined through the development of two characteristis in the mixture, one of which is resistance to the absorption of water, while the other is stability. The optimum quantity of emulsion to be used is that amount which will render the greatest resistance to water absorption without lowering the mixture's binding power and stability.

The best tests for determining this point are absorption tests and stability tests made on mixtures containing different amounts of stabilizing emulsion. Methods for making these tests will be found in my paper entitled "Soil Stabilization with Emulsified Asphalt" presented before the Fifteenth Annual Meeting of the Highway Research Board, December, 1935. Such tests can be made with simple equipment at any rock plant or can be made by an emulsion producer familiar with the work. The quantity of emulsified asphalt required with quarry waste is always very low. With 20% passing a #200 sieve usually only 7½ gallons of emulsified asphalt is required per ton. This gives an asphalt content of 1.65%, or about ¼ the asphalt which would be required if the asphalt were used as a binder.

Production Requirements

All that is necessary for a plant to go into the production of aggregates suitable for stabilization is a supply of quarry waste which can be made to contain sufficient cementitious material or clay to thoroughly bind it together when mixed with water and dried. Where the fines are not present in sufficient quantity a small amount of clay can usually be added at a minimum of expense.

The simplest mixing equipment will enable these plants to turn out a stabilized mixture ready for use in roads, airports, or city streets. As accurate grading control is unnecessary, several wash tests daily during the manufacture of these mixtures furnish sufficient control to make possible the turning out of a well stabilized mixture. The plant should be equipped with an aggregate weighing device which can be tripped into the mixer, and means for adding a controlled amount of emulsion and water, or a combination of the two, during the process of mixing.

Concrete Mixers are suitable for this work, but require somewhat more water to be added than a pug mixer. Only enough water should be used to allow the mixture to be handled readily so that it can be rolled upon its arrival at the job.

Screening and drying plants are unnecessary in the operation of a plant for this work. The aggregate can be used in its wet condition as it comes from the waste pile, as long as the amount of moisture contained therein is known so that it can be included in the mixing calculations.

TYPICAL STABILIZED RUNWAY WHEN FINISHED, OAKLAND AIRPORT—OAKLAND, CALIFORNIA

Mixtures made by the foregoing method are suitable for immediate use or for use from a stockpile maintained in the plant yard. The material can be

(Continued on page 10)

Low Cost Roads Will Multiply Stone Markets[1]

By RAY A. GIDDINGS

Secretary, Calcium Chloride Association, Detroit, Michigan

◆ Crushed stone, because of its angularity, is very well suited for use in stabilized road construction. In the present article Mr. Giddings tells how stone producers can sell their product in that market.

THE nation has lately wakened to the fact that two out of every three miles of our highways are quite unimproved; that for every mile of pavement there are 25 miles of side roads, most of which are sadly inadequate to their traffic requirements. Perhaps most concrete evidence of this awakening is the prominence of Farm-to-Market road improvement projects in the Federal Works Program, and the definite allocation of $25,000,000.00 or 1/5 of the total Federal Aid for Highways to secondary or feeder roads in the 1938 appropriation.

Economic considerations necessitate that these shall be low cost roads, while service requirements demand that they shall be all-weather roads. And to meet these requirements our soil physicists, geologists, and highway engineers have developed the comparatively new science for stabilization of soil-aggregates.

Because this new science makes it possible to utilize local materials when properly selected, graded and combined, and produce mixtures dense as concrete, practically impervious to water, and of sufficient stability to withstand traffic, stabilization has been rated as "the greatest discovery in road construction in years" by highest engineering authority.

Since we are definitely embarked upon an unlimited program of construction of low cost roads, and because we can build ten miles of such roads at the cost of one mile of pavement, and because nearly ten times as much aggregate will be used in this type of construction, it seems to me that the stone industry should be vitally interested in establishing its position so as to command an appreciable share of this tremendous market.

Requirements for Stabilization

To begin with, the primary requirements in stabilization are density and mechanical bond which in turn are dependent upon proper gradation, of coarse to fine aggregate. The very fact that in thousands of years of road building, the combination of stable material from natural deposits is so rare as to be almost unheard of, proves the practicability or necessity of selection of aggregates from sized and prepared materials.

Too, utilization of fixed proportions of material from uniform supply, insures pre-determined results, independent of variables in supply, handling and weather.

And of special significance is the fact, which I shall not attempt to explain, that according to researches into the physio-chemical reaction and the service behavior of stabilized *crushed* aggregates, a markedly greater adaptability and considerably increased cementation is noted.

I should like to make it clear that of various methods referred to as stabilization and utilized in treatment of soil, I am specifically referring to it as discussed in the February, 1935, issue of *Public Roads* and defined as:

"1. Use of graded materials with granular material and binder of such character and in such proportions as to furnish the required pore size.

"2. Treatment of road surface mixtures with deliquescent chemicals to stabilize the moisture content" and

"3. Densification of soil at the optimum moisture content or treatment with chemical electrolizers to facilitate the wetting of soil grains and decrease the thickness of the moisture films, * * *."

This method, which involves the use of clay as binder soil and calcium chloride as a deliquescent chemical, is the original, fundamental type classed as "Stabilization" and is unquestionably its most widely used and accepted form, and I should like the privilege of reading just a little further from the same report quoted above.

"While the stability of a cohesionless sand may be less than 300 pounds per square foot and that of a

[1] Presented at the Twentieth Annual Convention of the National Crushed Stone Association at Cincinnati, Ohio, January 18-20, 1937.

fairly stiff clay about 5,000 pounds per square foot, these two materials properly combined may have a supporting value of more than 17,000 pounds per square foot. As a matter of fact, only the cohesion of an almost liquid clay, about 130 pounds per square foot, is required to increase the supporting value of cohesionless sand from 270 pounds per square foot to 2,500 pounds per square foot.

"The essential consideration in stabilization is to provide the combination of internal friction and cohesion required to furnish the soil with high shearing strength. This quality is necessary in road surfaces, subgrades, and bases for thin wearing courses. Regardless of the methods used to provide high shearing strength, the success of the efforts will depend upon the permanent adhesive strength which can be developed by the minute films, whether of water or of special chemical substances which connect the soil particles.

"Absence of moisture films from soil road surfaces causes dust and raveling; too much moisture causes rutting. The dryer a road surface becomes as a result of evaporation, the wetter a rain will make it. This is because extreme dryness causes small cracks and fissures to form in the clay binder through which rain water may enter and soften the interior of the road surface. Fissures do not form in damp surfaces of properly selected constituents and water will be shed from the surface without injurious effect.

"Dampness of surface is desirable for another reason. All types of topsoil, gravel, traffic-bound and even water-bound macadam road surfaces acquire their final consolidation through compaction by traffic during what might be termed a period of seasoning following construction. When the surface is dry during this period the mineral binder powders under traffic and permits raveling of the surface, which requires extensive patching of the macadams and maintenance by means of mulch on the other types.

"If such surfaces can be maintained in a damp or slightly moist state the moisture films in the minute pores of the binder will prevent the separation of the granular particles and the shocks and blows produced by traffic become effective in gradually wedging the granular fragments into close association. The cohesion increases as the pores in the binder become smaller and finally the coarse aggregate, the sand, the filler, and the binder are formed into a stable, durable road structure.

"Calcium chloride is the principal chemical used in this type of stabilization although common salt has been used to a limited extent in experimental sections.

Function of Calcium Chloride

"The Highway Research Board's investigation disclosed, among other things, that calcium chloride placed upon the surface retards the evaporation of soil moisture and that the moisture film cohesion furnished by calcium chloride is more stable than that furnished by plain water. It also showed that during periods of low rainfall and high temperatures the sections treated with calcium chloride have the higher moisture content and that calcium chloride is retained best in compacted and undisturbed surfaces.

"The primary reason for the decrease in rate of evaporation is the low vapor pressure of the calcium chloride. A layer of the solution on the surface of the soil particle may be conceived of as an effective semi-permeable blanket through which the moisture from the soil has difficulty in reaching the surface where evaporation takes place.

"The hygroscopic property of calcium chloride causes absorption of moisture from the air during periods of high humidity and also slows up the rate at which soils lose moisture.

"The high density attained during compaction by traffic is indicated by dry weights of as much as 150 pounds per cubic foot, which have been observed for wearing courses treated with calcium chloride and common salt. Retention of the material in the highly compacted state accounts for the beneficial action of the chemical upon the preservation of the road material."

And for those who may be interested in a further study of its fundamental principles I should like to refer you to the February 1935 and May 1936 issues of *Public Roads*, both of which cover the subject in detail.

Market for Crushed Stone in Stabilized Roads

However, I simply want to give you some of the highlights and indicate the outstanding possibilities in this field for extended stone markets.

I think it is safe to predict that in a few years all of the aggregate used for road surfacing will be stabilized. Science has as greatly advanced its service qualities over the average natural gravel deposits, as the present day automobile over its earliest

model, and there will unquestionably be further developments and refinements. And in the use of stabilized aggregates we are by no means confined to surfacing of secondary roads, but it will be used as base course for all kinds of higher type surfacing, including black top, brick and concrete pavements, for shoulders and widening to increase the safety and traffic capacity of existing pavements, for city streets, and for many private uses in driveways, parking lots, playgrounds, etc.

It is a comparatively simple matter to supply stabilized material from a plant equipped to produce uniform graded aggregates. Here it is only necessary to combine fixed proportions of aggregate with a suitable binder soil and a moisture controlling admixture such as calcium chloride, and with suitable equipment attain an intimate mixture that will compact and consolidate readily.

It is quite a different matter for a highway engineer to establish soils testing personnel and facilities, to locate suitable natural sources of aggregates and binder-soil, to properly combine and manipulate his mixtures on the road or at his own plant, and to carry on the work subject to the hindrances of weather and traffic.

But unless the commercial producer recognizes the opportunity for developing the market, the engineer will work it out by his own efforts, with his own equipment and his own materials. Once he has been through this it may be practically impossible for the commercial producer to break into the work so as to be able to compete with him.

Advantages of Plant Mixed Stabilized Aggregates

There has been considerable engineering discussion of plant mixing of stabilized aggregates and while I won't read the list of them now I have it as part of this paper and incidentally can furnish reprints of most of them. However, I would like to give you some of the best arguments advanced for commercially produced stabilized aggregates.

It is found that plant mix construction can be just as economical as road mixing and has a number of advantages which may be mentioned as follows:

To the Aggregates Producer

(1) Possible utilization of soil strippings that are now waste material.

(2) Possible utilization, at a profit, of certain sizes of aggregate which may have accumulated as a surplus in the production of materials for other types of road surfaces.

(3) In metropolitan areas a substantial retail market may be developed for private drives, cemeteries, parking lots and similar uses.

To the Highway Official and Contractor

(1) A more uniform mixture than is obtained by blade-mixing on the road and greater ease and accuracy of laboratory control of the mixture.

(2) Expense of delays, due to waiting for materials to dry after periods of wet weather, are abolished.

(3) The season, during which stabilized roads may be built, is materially extended in many parts of the country.

(4) Dust nuisance during construction is eliminated and interruption of traffic is minimized.

(5) Much-needed maintenance equipment is not diverted from routine operation to construction work.

(6) Greater convenience and less cost of supplying the necessary water for the mixture. Less moisture loss by evaporation during construction than in road-mixing.

(7) The elimination, in municipal work, of much of the difficulty of blading over man-holes and crosswalks; also of the efficiency of blade-mixing on short sections.

(8) Plant-mixing enables municipalities and counties that do not own proper equipment for blade-mixing to obtain a complete stabilized mix of the desired quality.

In conclusion let me say that stabilization opens a means to low cost road improvement that multiplies the potential aggregates market by ten times over; that well over 2000 miles of the so-called calcium chloride stabilized roads now in use as city streets, county and state highways, have amply and convincingly demonstrated the practicability of the type, that the only way to take full advantage of the market is to "get in on the ground floor," and that crushed stone is a "natural."

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New Specification for Stone Ballast

AT A recent meeting of the American Railway Engineering Association, a revised specification for stone ballast was adopted. This specification is too voluminous to publish in detail at the present time, but it requires quality tests for absorption, toughness, percentage of wear and soundness. Instead of only one size requirement as in past A.R.E.A. specifications, the present specification gives a choice of several sizes as follows:

Size Designation	2A	3A	3B	23B
Nominal Size, Square opening	1—2"	½—1"	¾—1½"	¾—2½"
Approximate Size, Round opening	1¼—2½"	⅝—1¼"	⅞—¾"	⅞—3"
Square opening, Lab. Screen, in.	Total Per Cent Passing			
3	....	....	....	100
2½	100	....	....	90-100
2	90-100	....	100	....
1½	35- 70	100	90-100	25- 60
1	0- 15	90-100	20- 55	....
¾	0- 5	....	0- 15	0- 10
½	....	0- 15	....	....

Four classifications of ballast each with different specification limitations are also given.

Stabilized Quarry Fines for Base Construction

(Continued from page 6)

delivered to the job, spread to the desired thickness, and rolled without further wetting. The moisture contained therein is sufficient to allow of thorough compaction, and because of the mixture's uniformity a much higher degree of compaction is obtained than would be the case if the aggregate were to be delivered to the job in a dry condition and be wetted before rolling. A well designed mixture under rolling can be made to form a cream of stabilized binder on its surface which substantially fills all surface voids and forms a tough water resisting top.

During the slush rolling of a job of this kind it is possible to add a light application of emulsified asphalt stabilizer to the surface of the job so that during the rolling operation the slush carried ahead of the roller is enriched in asphalt content, making the road surface more resistant to abrasion. Jobs constructed in this way are sometimes suitable for bearing traffic without further preparation, but it is usually advisable to protect the surface from abrasion by covering it with a light asphaltic wearing surface.

In the foregoing, only the method of stabilizing the aggregate by plant mixing has been described. This method is preferred because of the ease of control and the resulting uniformity obtained. For those plants not wishing to manufacture and sell an already stabilized product, it is possible to promote the sale of an aggregate blend which can be stabilized in place on the road by usual road mixing methods.

Advantages of Stabilized Base Construction

Stabilized base construction has many advantages, among which is the fact that soil and rock mixtures properly made, maintain such a high degree of stability that they may not only be considered as being a base for paving surfaces, but they may also be figured into the total pavement thickness, thus making it possible to greatly reduce expenditures for more costly mixtures.

The process fits particularly well into the rock producer's program. It allows him to sell products formerly considered waste, and to turn out with these products a material superior to the best of the untreated base mixtures.

Future Policies in State and Federal Road Building[1]

By W. C. MARKHAM

Executive Secretary, American Association of State Highway Officials, Washington, D. C.

◆ What lies ahead in the field of State and Federal road building is a subject in which every crushed stone producer has a vital interest. In the following article Mr. Markham directs our attention to many significant considerations and we are indebted to him for a most complete and informative discussion.

IF YOU will tell me when the Federal Budget will be balanced I will tell you something definite about the Future Policies in State and Federal Road Building.

There must be plans for future road building in this country just as surely as there must be expenditures for an army and navy. There will never be such a thing as a road building holiday. Curtailment in road construction means increased expenditures for maintenance; not only for the highway, but also for the vehicles which use the highway. Presidents and Governors may trim their road expenditures temporarily, but this simply means that the next Administration will be compelled to increase the outlay. A well ordered, continuous, sanely planned road program, thoroughly substantiated by economic demands should be accepted by all those in authority as the only business-like policy.

Time was when it was necessary to prove to Federal legislators that Uncle Sam had an obligation to participate in the outlay for the construction of highways. That time has passed. Efforts have been made to have the Federal government retire from the field except in an advisory capacity. But advice is one of the cheapest by-products of the governmental functioning these days, and so it has become necessary to accompany this advice with a substantial contribution to carry any weight. When the Federal government accepted a direct obligation to ameliorate the unemployment situation, just that moment Federal obligations in road construction became a fixed Federal employment policy; for, road building, more than any other public expenditure, added to the wealth and social advancement of the people and at the same time gave the opportunity to thousands of men to earn their daily bread.

It has been the judgment of many that Federal contributions to road building should come from all general taxes levied for Federal expenditures since improved highways add to the sum total of the advanced economic and social life of our people, besides especially benefiting those who directly make use of highway transportation. The fact that the Congress has seen fit in the past few years to levy a direct tax on the road user even in an amount in excess of the Federal contribution to highways, in no way weakens the argument for a Federal contribution outside of these levies. Federal responsibility for building roads was an accepted policy before there was any tax on gasoline.

Federal Road Spending Policies

The first policy of the Federal government in determining its attitude toward highway construction and transportation, began, as it is well known, by the government interesting itself in the scientific side of road drainage and construction. This was rapidly followed by definite contributions toward road construction until today the amounts per year that are being contributed by the Federal government are far in excess of that hoped for by the most enthusiastic supporters twenty years ago. In addition to this policy, from year to year Federal appropriations have been added for the purpose of building roads in National Parks, National Forests, Indian Reservations, and even through Public Lands. In the latter case there are highways in western States which traverse thousands of acres of publicly owned land which are not susceptible to economic use under private ownership. Funds for the elimination of railroad grade crossings have also been contributed in the normal road programs, until, during the last few years, huge sums have been appropriated for this purpose, that do not even need to be matched by the States.

And now a new feature has been added by the last Congress in that the Federal government is making a definite contribution to Secondary roads, familiarly known as "Farm-to-Market" roads, which may not be, and in many cases are not, State or interstate in character.

[1] Presented at the Twentieth Annual Convention of the National Crushed Stone Association at Cincinnati, Ohio, January 18-20, 1937.

There are recurring bills being introduced in the Congress for complete federalization of some specifically mentioned interstate or transcontinental highway, not only to be controlled by the Federal government but to be constructed and maintained by the Federal government. It would seem that the forces which are demanding more Federal funds on minor roads are set for a very definite clash with those desiring to expend Federal funds on elaborate plans for highways which will carry high speed traffic.

The bill providing Federal assistance to the States in the construction of a secondary system of highways had not yet been printed in the statute books before the county commissioners in one State got together, figured out what their portion would be, and prepared to demand that their allotment should be pro-rated to the counties. This would give them about $3,000 per county. This dissipation of Federal funds for secondary highways would accomplish nothing, for $3,000 to a county would not build a mile of road per county. In view of the fact that the State and Federal Governments are now making traffic and economic surveys covering every mile of road of whatsoever kind, it is clearly a matter of good business judgment that the funds be allocated to projects made evident by the conclusions arrived at through this survey.

In contrast to the County Commissioners' plan, a leading financier of the country, directly interested in highway transportation, last month stated in a published interview that he thinks the time is ripe for the construction of a six-width highway across the continent. The only thing he sees to interfere with the immediate launching of this project is the securing of the finances. This is a spectacular statement, but is no more practical than the one advanced by the same group of financiers 16 years ago, who proposed that the Federal road expenditures be confined to a single highway extending from ocean to ocean. While this financier was securing "top of column next to reading matter" for his declaration, the State Highway Departments were concluding a year's work without ostentation, by adding improved mileages to the State systems exceeding a two-width road eight times as long as the distance from San Francisco to New York, and placing these improvements where they filled an immediate need. To those who are conversant with our real traffic necessities, a six-width highway across some of the States at the present time is both a political and economic impossibility. They are reminded of the suggestion made in good faith by a member of Congress before the Committee on Roads, that fires in the national forests could be prevented by the erection of lightning rods on each tree.

The near future will doubtless see highways constructed independent of the location of towns and cities but they will be limited in number and must be located in States which have enormous centers of population.

Highway Maintenance and Traffic Control

The Federal Government up to this time has not concerned itself about the management of the traffic over the highways, believing that to be a State matter exclusively. In addition to this the Federal Government never at any time has made any contribution toward the maintenance of highways already constructed although the tremendous increase in mileage of improved highways naturally adds the requirement of large sums of State funds for maintenance. Whether the Federal Government will permit any Federal funds to be used for maintenance is a matter that has been agitated in some quarters but up to the present time it is felt that the Federal Government should continue to encourage an increased mileage of constructed roads by limiting its contribution to construction only.

The last Congress delegated to the Interstate Commerce Commission authority over interstate travel of motor buses and trucks. This is an entering wedge for Federal control or supervision over the use of the highways. To what extent it will later on develop cannot be predicted. The necessity for control of these vehicles is self evident and probably would not have been entered into by the Congress had the several States arrived at a uniform method of controlling the situation.

Government Reorganization

There is now before the Congress of the United States a plan submitted by the President for a complete reorganization of the executive departments of the government. It is a wholesale job. The plan is to delegate to the President the authority for the consolidation or creation of new departments. One of the new departments proposed is the Department of Public Works. It is rumored that should this department be established that the Bureau of Public Roads will be absorbed into that department instead of being a bureau under the Department of Agriculture, as it is at present. This is not a new story. A

proposal of this kind has been made to every Congress for the past decade. There are some good arguments for it. The farm groups are not settled in their own minds as to whether they shall oppose this proposition. Some fear that if the Bureau is taken out of the Department of Agriculture that less consideration will be given to rural highways as illustrated by what are called "Farm-to-Market" roads. Others, for several years, have taken the position that the amount of money appropriated for highways is so large that it overshadows other appropriations for the Department of Agriculture and if it were eliminated from the sum total of appropriations for the Department of Agriculture they would secure more funds to fight the boll weevil, chinch bug and corn borer, not saying anything about land conservation, resettlement and reclamation.

So far as the State Highway Departments are concerned they are thoroughly satisfied with the present organization in the Federal Government, responsible for road building. However, should a change of location of the Bureau be determined upon by the Administration, State Highway Departments which, as you know, are responsible for this cooperative work with the Federal Government, will probably enter no protest providing the present functions and organization of the Bureau of Public Roads are maintained in the efficient and satisfactory set up now in force.

Traffic and Economic Surveys

Those who have followed with any degree of care the plans of the States and the Federal Government in looking into a future road building program, are aware that over forty State Highway Departments are now, in cooperation with the Bureau of Public Roads, making a survey which is inclusive of many more items than have heretofore prevailed in any State Highway survey. They are not only dealing with the State Highway Systems, which naturally have heretofore received their almost exclusive attention, but are including in their scope of investigation the whole rural highway system and the urban connections therewith. They are not limiting themselves to counting the traffic but are considering a variety of related investigations including a fiscal inventory of the existing highway facilities and highway financing, which naturally includes construction and maintenance, and with highways in their connection with all kinds of transportation. They are not limited in their conception to the facts as they now exist but are seeking to trace out the trends that will permit them to make a reasonable estimate of the ways and degrees to which these facts may be changed through any new economic or social forces now at work.

It has long been known that outside of the State Highway System, which is about 14 per cent of all of the roads of the United States, very little is really known of the condition, uses, and real value of the highways beyond the State system. While it is true that in some localities the urban or county roads are satisfactorily improved by officials in charge of their upkeep, still the great mileage of roads, running into the thousands, are not even accurately counted, let alone charted concerning the information which should be known considering future development of the territory they traverse.

To express in one sentence the results hoped to be obtained through this survey it might be said that it is to seek the facts concerning highway conditions, highway financing, the administration and use of highways, and finally the relation of highways to the general economic and social trend of society. Naturally one can envision that the information hoped to be secured will be as much in detail as was expected of the Army Intelligence Officers during the World War, who were required to secure all kinds of information that might affect the entire social fabric through the use of highways for transportation purposes. This information will not be secured in a day nor will it all be completed this year, but the rapidly developing demands of the highway and the proper protection of the best interests of all the people require that this detailed information be secured as a basis of future action on the part of both the Federal and State Governments.

Diversion and Transfer of State Funds

State construction and maintenance of highways, whether augmented by Federal funds or not, is becoming an increasing obligation. So much so that a few of the State legislatures have delegated to State authorities the responsibility of looking after all of the highways within their borders. Due to the fact that in this plan no increased funds were provided, the result is that this plan has slowed up in several cases the proper construction and development and rebuilding of State highways which carry the larger part of the traffic. But this seems to be an era of centralizing authority in many ways and the probabilities are that this plan will be increased during

the next few years. At least it is reasonable to expect that all town or township roads which now require the attention of purely local authorities will be centralized under county authorities as the smallest unit of political government responsible for the care of the highways.

It is well understood that during the depression years increased taxation was not politically profitable, and various methods were used to secure funds for relief and other worthy public functions by the diversion of gasoline and motor vehicle funds from their normal application, namely: for highways, so that in some States this diversion has worked a hardship in keeping funds for needed highway work. With a return to normal conditions (if such return is possible) it is anticipated that these plans of diversion will be abandoned.

During the past year about 16 per cent of the gross funds secured through the gasoline tax and the motor license fees were diverted to purposes other than for highways. However, this was not true in every State for seventeen States had no diversion—five of them having prohibited such diversion by constitutional amendment and in several other States the diversion was very insignificant. In order to relieve local tax budgets, highway funds, namely: the automobile and gas tax, in twenty-four States, have been transferred to local units to such an extent that 25 per cent above the 16 per cent diversion above referred to, of the total gross receipts from motor license fees and the gasoline tax, have been transferred to these local units. These funds, however, were designated for road purposes. In several States the local units having control of this fund diverted some of those road funds for other purposes. Should the Federal Government continue to make appropriations for secondary roads, the transfer of State funds to local political units may have some effect upon the policy of the Federal requirements in matching Federal funds with State funds.

Future Federal and State Appropriations

What Federal appropriations will be made in the immediate future to cooperate with the States in road construction does not concern the present session of Congress. Liberal authorizations have been made to continue until June 30, 1939. While some persons for purposes of their own have repeatedly stated in public and in print that a Federal authorization for roads is not an appropriation, it should be clearly understood by the public that the Federal law itself now provides that all authorizations for highways when made by the Congress immediately become a contractual obligation with the States and no further legislation is needed except to place in the Appropriation Bill the actual cash needed from time to time as reported to the Congress by the Bureau of Public Roads, which Bureau is required to make such payments as vouchers are presented by the States.

The Federal contributions during the last several years toward highways have been very generous. These have been based however upon the argument of aiding the unemployed. It cannot be expected that the Federal Government will continue indefinitely these large appropriations if there is any attempt at all made to adjust the Federal expenditures to the Federal income.

During 1936 the Federal payments to the States exceeded $328,212,000, which doubtless was the peak Federal payment under the emergency road building programs prevailing during the past few years. The Federal payment during the calendar year 1937 will be slightly below that of 1936.

In 1935 the State construction program alone, including both Federal and State funds, amounted to over $416,000,000. This was exceeded in 1936 (exact figures not yet being available), and will again be exceeded in 1937.

Location of Highways

The location of a highway is of major importance in the construction of a safe road, but thousands of miles of highways were located and travelled long years before we had dreamed of motor vehicles on the road. When road building of the present standards began, it was necessary to improve roads already in use, however improperly located they might be, as far as making a modern highway is concerned. Towns and cities were connected by these roads and the rural population to a great extent was located along these highways. That condition still exists and does not permit the location of a new road until present demands for the modern improvement of these roads are met.

Relocation of highways comes slowly. The ability to secure right-of-way is sometimes prohibitive and it is necessary to construct an alternate route. It is now the policy of the State Highway Departments, in cooperation with the Federal Government, whenever funds are available, to construct "by-pass" routes around large centers of population for the

benefit of through travel and to relieve congestion in the business centers of the towns and cities. This activity has been fought frequently by some progressive cities, but of late they are beginning to realize that this kind of traffic is of no particular financial benefit to the cities and is often a deterrent in accommodating the normal trade to which the city is entitled.

It is not possible to allocate the major part of State funds for highways to the relocation of existing roads. There is a constant demand for new roads—that is, the improvement of highways which as yet have not received adequate surfacing to take care of the traffic needs. While it is true that more than 80 per cent of the people of this country (which, of course, includes those living in the cities) live on the State system of highways, yet the remaining percentage, small as it is in comparison, want dustless roads, constructed with perfect curves, long sight distance, and every other modern method of construction that will permit them to drive at high speed.

Financing Highways

You can't have improved highways unless somebody pays the bill. The size of the road-building program depends upon the size of the appropriation made for that purpose. The increase or decrease of the gas tax and motor fees regulates the number of miles which can be added to the improved road systems.

For some months organizations interested in the sale of gas have been publishing information with the thought of prejudicing the driving public against the present rates in force. Here is one of their arguments, appearing on the front pages of the press within the last month: "Gasoline taxes soar.—The average price of gasoline dropped from 21.06 cents a gallon in 1923 to 14.06 cents a gallon as of October 1, 1936. Taxes on gasoline, however, have risen from an average of .91 cent a gallon in 1923 to 5.34 cents this year."

Now everybody knows that through the scientific development of the processes for extracting gasoline from crude oil, the manufacturers now secure double the amount of gasoline per gallon of crude oil as was obtained some years since. Naturally the price of gasoline has dropped, which automatically creates greater consumption, but dividends on oil stock have not been reduced, and no one can brazenly say that the profits in the gasoline business have suffered. Therefore why the comparison? The gasoline producer is not giving the public anything—not if he can help it.

On the other hand, in 1923 the State gas rate averaged 1.8 cents per gallon in the thirty-five States which had a gas tax—not .91 of a cent. The average rate today is 4.18 cents, not counting the Federal 1 cent tax.

Do these oil companies believe that the driving public would prefer to go back to 1923 and slow up the road building program? Everybody knows full well that the motor fees and gas tax paid by the people have been transferred into roadbed, bridges and elimination of railroad grade crossings. In 1923 there were 80,200 miles of surfaced roads of all kinds in the United States. Today there are close to 400,000 surfaced miles on the State systems alone and over 585,000 surfaced miles on county and township roads. The improved mileages in 1923 were but a little over 8 per cent of what they are today.

It is true that many people think that Uncle Sam should not tax gasoline, but from 1917 to 1924 his total contribution for highways was $452,000,000 (an 8-year period). During the past year alone he authorized the expenditure of $525,000,000 for State roads.

Dangers in Transportation

All methods and plans for transportation of human beings, from place to place with alacrity, have always carried with them the element of danger and death. Despite this inherent difficulty, the impatience of many to accomplish this end has caused them to ignore constantly the value of a human life; and so the same mind that has been able to enlarge its physical vision and transmit its thought with lightning rapidity, becomes unmindful of lurking danger in its urge for speed in the transportation of the body, without which the mind would have no earthly existence.

We glory in the obliteration of what we call handicaps. Some people would rather gloat over the fact that they traveled 100 times farther in a single day than their fathers did, although in so doing they had not noticed the changing autumnal hues of the forests whose glory would not be if the trees did not stand and wait for well-merited admiration.

Speed vs. Safety

Speed and safety both begin with a crooked letter, "S". Both must be supervised with constructive in-

telligence in which carelessness, indifference, and brutal stupidity should have no consideration. Even financial greed should be submerged to a proper consideration of human rights, not the least of which is the right to live. The Automobile Manufacturers' Association very recently found it necessary to secure an agreement from their members to desist from laying stress, in their advertisements, upon the greatly increased speed of their new models, as an incentive for the public to sell the old car and get a new one. Streamlined cars are now being made to decorate streamlined highways, but stress should be laid on improved brakes, more perfect control, and durability of construction.

It is impossible—because of excessive costs—to meet the individual demands for high-speed highways created by the manufacturer of the machine and the willingness of someone to try it out in the road. We all recognize that it is necessary to design roads for the *needs* of the service, but right here the question arises as to what the *service* needs. As J. W. Wheeler of Indiana recently stated: "No matter how many conferences we hold, no matter how loud we lament on traffic accidents, no matter how drastic we make traffic rules and regulations, no matter how many highway policemen we appoint, as long as the automotive designer puts 120 miles under the hood, the red-blooded boys and girls after a high school dance will get 120 miles out of that car, and some of their fathers and mothers will be equally as guilty."

Highway Department officials admit that there are miles of roads travelable under normal conditions but which will not guarantee unlimited speed. The question has rightly confronted us as to *how valuable our time is.* E. C. Lawton of New York put it this way: "What price are we paying and what price are we willing to pay for speed, weight and size of motor vehicles on our highways? It is obvious, of course, that we are willing to pay some reasonable price in dollars and cents to make use of reasonable speed, weight and size of motor vehicles, but we should be unwilling to pay in human life in order to exercise our so-called inalienable right to use speed, weight and size of vehicles of our own choosing. Perhaps the worst indictment of all is that we restrict by law or regulation the maximum permissible weight of vehicles to save *our pavements,* but so far we have failed or refused to restrict by law or regulation the maximum permissible speed of vehicles to save our *people* from death and injury on our rural highways."

We are urged to build highways so that people can drive without fear of accidents, but the better the roadbed, the faster they drive. Men have been known to go to sleep at the wheel, owing to the long continuously monotonous straight road. Not every accident is due to excessive speed, but every one of my hearers can recall numerous cases where, if there had not been excessive speed, lives would not have been needlessly snuffed out. A properly tired car never grows weary in giving proper service, but a smooth tire upon a smooth highway courts disaster.

Design vs. Accidents

A scientific study made through several independent sources clearly indicates that the design of the highways is responsible for but a very small proportion of the fatal accidents, and some reports show that defects in the roadway are responsible for less than 1 per cent of the fatal traffic accidents. There is no disposition on the part of the Highway Departments not to correct locations or improve designs for construction of highways to their highest efficiency. Most States have a traffic engineer whose business it is to keep the construction department fully advised as to places in highways which should receive first consideration in reconstruction or relocation based on traffic hazards and accidents. There is no need to discount the fine work that has been accomplished in order to increase the road program.

Another demand made upon the Highway Departments is for the construction of divided highways and elevated roads. People who want to sell, and those who want to drive, high-powered machines at a rate of speed in excess of what is now the maximum speed allowed in most States, desire this most modern plan of road construction. A three-lane road has been a bone of contention so far as safety is concerned for years. A four-lane road, without being divided, is not accident proof. Even the Holland Tunnel with all the safeguards surrounding its operation, has had to report accidents and deaths.

Divided or separated highways are being constructed as a safety measure where traffic needs demand and the people of that locality are willing to pay the bill.

The fact that the opening of the Tri-Borough Bridge in New York City has created a traffic of almost 40,000 vehicles a day ever since its recent opening, is one indication of what patronage, even on a toll road, might be given in a limited number of localities. Such construction, however, is more in the line of expediting travel than it is in the preven-

tion of accidents. We have a demand these days to eliminate space between objective points by the reduction of the time it takes in an ordinary way to travel between them. If those who want these highways pay for them personally by direct toll and these roads are a financial success, they are entitled to them and it may add to the safety in transportation as well. Highway Departments have always advocated free roads and bridges, or publicly owned tolls where conditions may make other policies temporarily necessary.

Without question designs of new roads are calling for longer sight distance, greater width, shoulders for stopping off the pavement, surface non-skid and roads lighted in sections where generous right-of-way cannot be secured and dangerous curves cannot be wholly eliminated. But through it all there is a clarion call for control of speed at these points and officials to see that regulations are observed.

The Driver

The road and the car may be as perfect for the time being as human ingenuity can make them, but the fellow who is permitted to use his modern car on this perfect highway, can easily bring disaster. The ultimate test in proper control of highway transportation is the driver. Not everyone is competent to drive an engine. Some people find it difficult to control their brain cells in any capacity, much less when they are confronted with the power given them in driving upon the highways. It is proposed that we should make the roads "fool-proof," but the trouble is that a "fool-proof" road today may not have taken into consideration "the fool" who will be turned loose upon the highways tomorrow. In reality we are not concerned about automobile accidents but with human accidents through the use of the automobile. Defects in automobiles are infinitesimal in comparison to defects in the human mechanism supposed to control the car.

The engineer on a railroad, by long process of instruction and education, is permitted to run a train on a track which needs no white or yellow stripes to guide him, and even then he pulls the throttle only when he has in his hand telegraphic orders to proceed. Yet we place a high-powered engine, being made more powerful every year by the inventive genius of the manufacturer, into the hands of anyone who has the means to buy; without any examination whatsoever in some States and a very perfunctory one in others. Then he is permitted to drive on a highway neither circumscribed by a steel rail nor subject to telegraphic orders. And the worst of it all is that a license to drive does not provide against a "drinking driver" or a speed fiend.

A Washington paper announced last Saturday that word had been received from hell announcing that people were arriving in increasing numbers at the rate of 70 miles per hour.

And now abideth, the driver, the car and the road —but the greatest of these is the road.

Why? Because roads were here before the driver was born or the car made. The driver berates it and the car hammers it, but the road carries them on its back without a murmur, so long as they behave. The coat of the road grows threadbare and often needs a new weave. It sometimes carries its load more easily by changing its prostrate position, but those who watch over it neither slumber nor sleep. In storm or sunshine they see that it is ready for service; and, with the means afforded them, make sure that its coat is properly adjusted.

The driver lives a few years, the car travels a few miles, but the open road goes on to the end of time.

Road Program Made Work for Many, Says MacDonald

THE highway program to relieve unemployment administered by the Bureau of Public Roads of the U. S. Department of Agriculture had resulted in the construction of 38,220 miles of road at the close of the last fiscal year, according to the annual report of the Bureau. These roads cost $636,622,561, of which $571,276,033 was paid by the Federal government, says Thos. H. MacDonald, chief of the bureau. The mileage completed during the year, with funds apportioned to all States, was 13,789.

Under the emergency grade-crossing program, projects approved or under construction included 1,407 new crossing eliminations, the reconstruction of 198 existing structures, and the protection without elimination of 322 crossings, at a total cost of $133,524,019, of which the Federal share was $130,681,697.

During the last three years, this road construction and that carried on under other appropriations in Federal areas of various kinds has provided nearly 6,000,000 man-months of direct employment, or an average rate of 2,000,000 man-months per year, which is approximately double the average of employment furnished in the two years preceding the beginning of the enlarged emergency program.

Notable Victories Won in Gas-Tax Diversion Fight

THE nationwide "sit-down" strike by automobile and truck owners against the continued misappropriation of gasoline and motor-vehicle highway-tax money paid by them for the building and upkeep of good and safe State roads has won for them decisive victories on two important fronts.

Governor Harold G. Hoffman of New Jersey vetoed a bill on April 5 which, if passed, would bring about the diversion of approximately eight million dollars in highway-tax funds intended for highway purposes to the relief of unemployment in that State.

Maryland's legislature decided on the same day to put an end to any chance for further misuse of its highway-tax revenues by passing a bill returning $3,300,000 to its highway program, $1,300,000 of which is already earmarked for specific road projects. This money had been slated for diversion to balance the State budget and caused Maryland to be the first State to be penalized by the Federal government as provided by authority of Section 12 of the Hayden-Cartwright Road Act. Notified that one-third, or $341,666 was to be sliced from the State's Federal-aid apportionment for its highway program, Maryland decided to reconsider and passed the bill restoring sufficient funds to its highway program to eliminate imposition of the diversion penalty by Uncle Sam.

In vetoing the New Jersey bill proposing the diversion of approximately eight million dollars in highway money to unemployment relief, Governor Hoffman issued a statement of opinion.

"A popular cry of the pro-diversionists has been 'concrete or bread'. Like the slogan 'economy before new taxes,' this does not represent a policy, but a shibboleth designed to make a popular appeal and to facilitate elections. The real issue is between a melodramatic slogan, 'Concrete *or* Bread,' and a sound policy that will provide both 'Concrete *and* Bread'. Work upon our highways provides honest bread for honest workers who are creating capital assets that will be useful to them and to their children. Diversion for relief purposes provides, on the other hand, crusts of charity for people who cannot find work, or who will not work. We must feed the hungry until they can feed themselves. Our real obligation is to create jobs and opportunities to earn, not to perpetuate unemployment."

Charles M. Upham, engineer-director of the American Road Builders' Association, considered this action by New Jersey and Maryland as significant triumphs for the automobile and truck-owning taxpayers of America.

"The cry of 'Down with Diversion' has flooded the chambers of legislatures throughout the nation. Legislators, farm and trade organizations, motorist associations, millions of individual automobile and truck owners and other numerous intensely interested persons throughout the 48 States have revolted against the misappropriation by any State of its highway-tax funds for any use other than the building and upkeep of good and safe roads. Governor Hoffman and the Maryland legislature are to be congratulated for their intelligent decisions. During the fiscal year 1936 highway building in State and Federal projects alone supported over a million people. With the growing need for more good farm-to-market roads, for the modernization of antiquated roads and for the building of safety into the new highways that

American Road Builders' Association

must be constructed, the national highway program will continue to take care of more than its share of persons gainfully employed. The prosperity of a State can only be brought about by the people who work for and take part in attaining that State's prosperity. How better can a State employ its people than in the building of roads?"

Germany to Build 5,000 Miles of Superhighways

THROUGHOUT Germany paving mixers are at work building the world's greatest system of superhighways—5,000 miles of four and six-lane roads.

These roads are being built both for high speed and for safety. The wide roads have parkways which separate opposing flows of traffic. These dividing strips eliminate head-on collisions and accidents due to headlight glare and sideswiping.

The roads are being designed for a speed of 112 miles per hour, which means that cars will be able to travel from the eastern border of Germany to its western border in less than seven hours.

Towns and cities are by-passed. All intersections with other highways and railroads are provided with grade separations, so intersection accidents are built out. All curves are well banked and adequate sight distance for high speeds is being provided throughout the system.

When the system is completed, superhighways will extend to all border towns of any prominence and easy access will be provided from almost any point in Germany to Berlin. More than 600 miles of the superhighways have been completed and contracts have been let for the early construction of hundreds of miles more.

The total cost of the superhighway system has been estimated at $800,000,000 with jobs provided for about a half million workers during the seven years of the program.

According to construction records of June 1, 1936, 94 per cent of the superhighway pavement is of concrete. It is figured that to build the 10,000 necessary bridges about 5,000,000 cu. yd. of concrete and 500,000 tons of steel will be used.

The superhighway system is a part of Germany's campaign to motorize the nation. In 1932 there were only 52,000 motor vehicles in Germany, but by 1935 the number had quadrupled. (*The Traveler.*)

America's Worst Road

THERE'LL be no more deliveries of the United States mail on Rural Route No. 2 out of Rockville, in Montgomery county, Maryland. "America's worst road" has completely defeated the efforts of the rural letter carrier of that section. At his own request, despite the fact that it means a decrease in his salary, the service to that particular community has been discontinued by the Postoffice Department.

This situation is one of the rare instances in the history of rural free mail delivery where the condition of a "backroad" has become so bad that even the rural letter carrier has been unable to get through. Rarely have these public servants given up completely, as in the case of the carrier out of Rockville, Maryland, for it is their job to get the mail through at all hazards. But, when a road is labelled "America's worst road" by the inhabitants of the community through which it purports to run and is then substantiated by its rural letter carrier personally requesting that service on that road be discontinued, regardless of the loss of money in salary to him, then it must really be a poor semblance of a road.

The deplorable condition of secondary roads throughout the country is not due to inefficiency and lack of co-operation on the part of the State highway department. It is due to the lack of funds specifically created for the purpose of constructing and maintaining the feeder-type road. Fortunately, $25,000,000 has been set aside by the Hayden-Cartwright Road Act of 1936 for rural road projects.

According to the definition as outlined in Section 1 of the Hayden-Cartwright Act, " 'secondary or feeder roads' shall mean roads outside of municipalities, except as hereafter provided, which are not included in the Federal-aid highway system, and shall include farm-to-market roads, mine-to-market roads, rural free delivery mail roads, public school bus routes and other rural roads of community value which connect with important highways or which extend reasonably adequate highway service from such highways, or which lead to rail or water shipping points or local settlements. The limitation with respect to roads within municipalities shall not be construed to prevent improvements into or through small municipalities when such improvements are necessary for continuity of service."

MANUFACTURERS' DIVISION

of the

NATIONAL CRUSHED STONE ASSOCIATION

These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.

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Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Tractors

American Bitumuls Co.
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Bitumuls—Hot and cold mixes, Penetration and Stabilization

American Cyanamid & Chemical Corp.
Explosives Department
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American Manganese Steel Co.
389 E. 14th St., Chicago Heights, Ill.
Manganese Steel Castings, Renewable Lip Dippers

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C. G. Buchanan Crushing Machinery Division of the Birdsboro Steel Foundry and Machine Co.
90 West Street, New York City
Primary, Secondary and Finishing Crushers and Rolls

Bucyrus-Erie Co.
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Cross Engineering Co.
Carbondale, Pa.
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Electric Motors

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Gruendler Crusher and Pulverizer Co.
2915 N. Market St., St. Louis, Mo.
Rock and Gravel Crushing and Screening Plants, Jaw Crushers, Roll Crushers, Hammer Mills, Lime Pulverizers

Hardinge Co., Inc.
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Harnischfeger Corp.
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A complete line of Power Excavating Equipment, Overhead Cranes, Hoists, Smootharc Welders, Welding Rod, Motors and Generators

Hayward Co.
50 Church Street, New York City

Hendrick Mfg. Co.
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Perforated Metal Screens, Perforated Plates for Vibrating and Shaking Screens, Elevator Buckets, Hendrick Vibrating Screens

Hercules Powder Co.
Wilmington, Del.
Explosives and Blasting Supplies

Illinois Powder Mfg. Co.
1752 Pierce Bldg., St. Louis, Mo.
Gold Medal Explosives

The Jeffrey Mfg. Co.
Columbus, Ohio
Material Handling Machinery, Crushers, Pulverizers, Screens, Chains

Kennedy-Van Saun Mfg. and Eng. Corp.
2 Park Ave., New York City

Kensington Steel Co.
505 Kensington Ave., Chicago, Ill.
Manganese Steel Castings, Dipper Teeth, Crawler Treads, Jaw Plates, Concaves and Hammers

Koehring Co.
3026 W. Concordia Ave., Milwaukee, Wis.
Mixers, Pavers, Shovels, Cranes, Draglines, Dumptors, Traildumps, Mud-Jacks

Lima Locomotive Works, Inc.
Shovel and Crane Division
1108 Lima Trust Bldg., Lima, Ohio
Power Shovels, Draglines and Cranes

Link-Belt Co.
300 West Pershing Road, Chicago, Ill.
Screening, Washing, Conveying Equipment

Ludlow-Saylor Wire Co.
Newstead Ave. & Wabash R. R., St. Louis, Mo.
Woven Wire Screens and Wire Cloth of Super-Loy, Manga-Loy and all commercial alloys and metals

Marion Steam Shovel Co.
Marion, Ohio
A Complete Line of Power Shovels, Draglines and Cranes

The National Supply Co. of Delaware, Superior Engine Division,
1401 Sheridan Ave., Springfield, Ohio
Diesel engine equipment

Nordberg Mfg. Co.
Milwaukee, Wis.
Cone Crushers, Vibrating Screens, Classifiers, Diesel Engines, Steam Engines, Compressors, Mine Hoists, Underground Shovels, Track Maintenance Tools

Northern Blower Co.
65th St. south of Denison, Cleveland, Ohio
Dust Collecting Systems, Fans—Exhaust and Blowers

Northwest Engineering Co.
28 E. Jackson Blvd., Chicago, Ill.

Pioneer Gravel Equipment Mfg. Co.
1515 Central Ave., N. E., Minneapolis, Minn.
Jaw Crushers, Roll Crushers, Horizontal Gradation Screens, Inclined Vibrating Screens, Revolving Screens, Belt Conveyors, Belt Conveyor Units, Quarry and Rock Plants

Pit and Quarry Publications
538 South Clark St., Chicago, Ill.
Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory

Robins Conveying Belt Co.
15 Park Row, New York City
Belt Conveyors, Bucket Elevators, Gyrex and Vibrex Screens, Feeders, Design and Construction of Complete Plants

Rock Products
205 West Wacker Drive, Chicago, Ill.

Simplicity Engineering Co.
Durand, Mich.
Simplicity Gyrating Screen, Simplicity D'centegrator, Simplicity D'watering Wheel

Taylor-Wharton Iron & Steel Co.
High Bridge, N. J.
Manganese and other Special Alloy Steel Castings

The Texas Co.
135 E. 42nd St., New York City

The Thew Shovel Co.
Lorain, Ohio
Power Shovels, Cranes, Crawler Cranes, Locomotive Cranes, Draglines. Diesel Electric, Gasoline. 3/8 to 2-1/2 cu. yd. capacities

The Traylor Engineering & Mfg. Co.
Allentown, Pa.
Stone Crushing, Gravel, Lime and Cement Machinery

Troco Lubricating Co., Inc.
2728-34 N. Salmon St., Philadelphia, Pa.
Troco Crusher Grease, Troco Safety Lubricants

Trojan Powder Co.
17 N. 7th St., Allentown, Pa.
Explosives and Blasting Supplies

The W. S. Tyler Co.
3615 Superior Ave., N. E., Cleveland, Ohio
Wire Screens, Screening Machinery, Scrubbers, Testing Sieves and Dryers

Warren Brothers Roads Co.
P. O. Box 1869, Boston, Mass.
or
38 Memorial Drive, Cambridge, Mass.
Complete plants and separate plant units for bituminizing all types of stone, sand and gravel aggregate paving mixtures

Westinghouse Electric and Mfg. Co.
East Pittsburgh, Pa.
Transformers, Switching Equipment, Locomotives, AC and DC Motors and Control, MG Sets, Welding Equipment, Gear Motors